

## PATENT ABSTRACTS OF JAPAN

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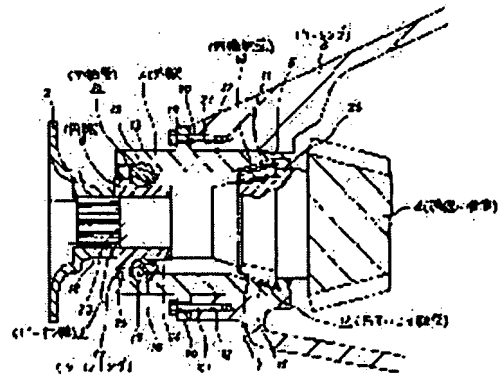
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## (54) BEARING UNIT FOR SUPPORTING PINION SHAFT OF DIFFERENTIAL GEAR

## (57)Abstract:

PROBLEM TO BE SOLVED: To reduce the cost, and to improve the performance by facilitating the control of the pre-load of a tapered roller bearing and a ball bearing.

SOLUTION: A pinion shaft 1 is rotatably supported by a tapered roller bearing 12 and a ball bearing 16 on the inner side of an outer ring 6 fixed to a casing 3. An inner ring raceway 10 to constitute the tapered roller bearing 12 is formed directly on an outer circumferential surface of the pinion shaft 1. Because the dimensional errors of components and the assembly errors are not integrated, the pre-load of the tapered roller bearing 12 and the ball bearing 16 can be easily controlled.



## LEGAL STATUS

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CLAIMS

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## [Claim(s)]

[Claim 1] The pinion shaft which fixed the moderation pinion which enables connection of the end section at the edge of a driving shaft, and meshes with a moderation main wheel to the other end, The outer ring of spiral wound gasket fixed to this casing where it has been arranged around this pinion shaft at this pinion shaft and this alignment and the side attachment wall of casing of a differential gear is penetrated to an oiltight, It is prepared between the two-place location isolated to shaft orientations by the inner skin of this outer ring of spiral wound gasket, and the two-place location isolated to shaft orientations in the pars intermedia of the above-mentioned pinion shaft. One pair of anti-friction bearings which support the two-place location isolated to shaft orientations free [ rotation ] to the above-mentioned casing in the pars intermedia of this pinion shaft, It is prepared in the end section inner skin, the above-mentioned pinion shaft, or this pinion shaft of the above-mentioned outer ring of spiral wound gasket between the peripheral faces of the inner ring of spiral wound gasket by which outer fitting immobilization was carried out. It has the seal ring with which the lubricating oil which exists in the above-mentioned casing prevents revealing outside. The first anti-friction bearing supported for a side far from the above-mentioned moderation pinion among the above-mentioned pinion shafts, enabling free rotation is a ball bearing. In the bearing unit for pinion shaft support of the differential gear whose second anti-friction bearing supported for the same side near the above-mentioned moderation pinion, enabling free rotation is circular-cone roller bearing The bearing unit for pinion shaft support of the differential gear characterized by forming in the peripheral face of a pinion shaft directly the inner-ring-of-spiral-wound-gasket orbit which constitutes the above-mentioned circular-cone roller bearing.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to amelioration of the bearing unit for pinion shaft support of a differential gear for supporting the pinion shaft which constitutes the differential gear (the last reducer) of an automobile free [ rotation ] inside casing (differential case).

[0002]

[Description of the Prior Art] As a differential gear which changes a hand of cut into a right angle, structure as shown in drawing 2 is indicated by JP, 53-74653, A at the same time it prepares in the middle of the power transfer system of an automobile and slows down rotation of a driveshaft. First, it explains about structure conventionally which was shown in this drawing 2. In addition, in the case of the differential gear for FR vehicles (front-end engine rear drive vehicle), the cross direction in the following explanation is described. In the case of the differential gear included in automobiles which have drive formats other than FR vehicle, such as FF vehicle (front-end engine front drive vehicle), RR vehicle (postposing engine rear drive vehicle), and a midship engine vehicle, a cross direction is not necessarily the same.

[0003] The front end section (left end section of drawing 2) of the pinion shaft 1 arranged in the cross direction (longitudinal direction of drawing 2) of a car is enabling connection in the back end section of the driveshaft which is not illustrated by the end flange 2 which carried out outer fitting immobilization at the front end section of this pinion shaft 1. Moreover, the moderation pinion 4 is fixed to the part located in the casing 3 which dedicated the differential gear in the back end section (right end section of drawing 2) of the above-mentioned pinion shaft 1. This moderation pinion 4 meshes with the moderation main wheel which was supported free [ rotation ] in the above-mentioned casing 3 ] and which is not illustrated.

[0004] The cylinder-like through tube 5 which makes the last side attachment wall of the above-mentioned casing 3 open the inside and outside of this casing 3 for free passage is formed, and only rotation is supporting the above-mentioned pinion shaft 1 free inside this through tube 5. That is, while carrying out screwing immobilization of the outer ring of spiral wound gasket 6 of a cylindrical shape inside the above-mentioned through tube 5, outer fitting immobilization of one pair of inner rings of spiral wound gasket 7 and 8 is carried out approximately at the above-mentioned pinion shaft 1. And 11 and 11 are prepared at two or more circular-cones time between the outer-ring-of-spiral-wound-gasket orbit 9 formed in the back end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner-ring-of-spiral-wound-gasket orbit 10 formed in the peripheral face of the inner ring of spiral wound gasket 7 on the backside, and the circular-cone roller bearing 12 is constituted. Moreover, two or more balls 15 and 15 are formed between the outer-ring-of-spiral-wound-gasket orbit 13 formed in the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner-ring-of-spiral-wound-gasket orbit 14 formed in the peripheral face of the inner ring of spiral wound gasket 8 by the side of before, and the ball bearing 16 is constituted. The above-mentioned pinion shaft 1 is supported free [ rotation ] to the above-mentioned casing 3 by these circular-cones roller bearing 12 and the ball bearing 16. Furthermore, the periphery edge of a seal ring 17 is stopped to the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner circumference edge of this seal ring 17 is made to \*\*\*\* on the front face of the inner ring of spiral wound gasket 8 which constitutes the above-mentioned ball bearing 16.

[0005] At the time of operation of the differential gear constituted as mentioned above, the moderation main wheel which is not illustrated rotates with rotation of the above-mentioned pinion shaft 1. This moderation main wheel runs through its lubricating oil (differential oil) stored in the above-mentioned casing 3. Consequently, the droplet of a lubricating oil enters in the above-mentioned outer ring of spiral

wound gasket 6, and the lubrication of the above-mentioned circular-cone roller bearing 12 and the ball bearing 16 is carried out.

[0006]

[Problem(s) to be Solved by the Invention] Precompression management of the circular-cone roller bearing 12 for [ which was shown in drawing 2 ] supporting the pinion shaft 1 in the case of structure, enabling free rotation and a ball bearing 16 is conventionally difficult. That is, in the case of structure, it has the inner rings of spiral wound gasket 7 and 8 which carried out mutually-independent conventionally [ above-mentioned ], and outer fitting immobilization of each [ these ] inner rings of spiral wound gasket 7 and 8 is carried out at the pinion shaft 1, respectively. And the binding force of the nut 28 for fixing an end flange 2 to the front end section of the pinion shaft 1 is adjusted, the force which presses the one above-mentioned pair of inner rings of spiral wound gasket 7 and 8 to shaft orientations is regulated, and precompression management of each above-mentioned bearing 12 and 16 is aimed at.

[0007] When the precompression of each [ these ] bearing 12 and 16 is managed with such structure, it is hard coming for the pile of each above-mentioned inner rings of spiral wound gasket 7 and 8, the pinion shaft 1 and the dimension error of an end flange 2, or an attachment error to perform exact precompression management. The bearing unit for pinion shaft support of the differential gear of this invention is invented in view of such a situation.

[0008]

[Means for Solving the Problem] The bearing unit for pinion shaft support of the differential gear of this invention The pinion shaft which fixed the moderation pinion which enables connection of the end section at the edge of a driving shaft, and meshes with a moderation main wheel to the other end like the bearing unit for pinion shaft support of the conventional differential gear mentioned above, The outer ring of spiral wound gasket fixed to this casing where it has been arranged around this pinion shaft at this pinion shaft and this alignment and the side attachment wall of casing of a differential gear is penetrated to an oiltight, It is prepared between the two-place location isolated to shaft orientations by the inner skin of this outer ring of spiral wound gasket, and the two-place location isolated to shaft orientations in the pars intermedia of the above-mentioned pinion shaft. One pair of anti-friction bearings which support the two-place location isolated to shaft orientations free [ rotation ] to the above-mentioned casing in the pars intermedia of this pinion shaft, It is prepared at the end section inner skin, the above-mentioned pinion shaft, or this pinion shaft of the above-mentioned outer ring of spiral wound gasket between the peripheral faces of the inner ring of spiral wound gasket by which outer fitting immobilization was carried out, and has the seal ring with which the lubricating oil which exists in the above-mentioned casing prevents revealing outside. And the first anti-friction bearing supported for a side far from the above-mentioned moderation pinion among the above-mentioned pinion shafts, enabling free rotation is a ball bearing, and the second anti-friction bearing supported for the same side near the above-mentioned moderation pinion, enabling free rotation is circular-cone roller bearing. Especially, in the bearing unit for pinion shaft support of the differential gear of this invention, the inner-ring-of-spiral-wound-gasket orbit which constitutes the above-mentioned circular-cone roller bearing is directly formed in the peripheral face of a pinion shaft.

[0009]

[Function] The operation at the time of the bearing unit for pinion shaft support of the differential gear of this invention constituted as mentioned above supporting a pinion shaft, enabling free rotation, and transmitting rotation of a driving shaft to a moderation main wheel through this pinion shaft and a moderation pinion is the same as that of the case of structure conventionally which was mentioned above. Especially, by having formed the inner-ring-of-spiral-wound-gasket orbit of circular-cone roller bearing in the peripheral face of a pinion shaft directly, in the case of the bearing unit for pinion shaft support of the differential gear of this invention, a component part decreases, and the dimension error of a component part becomes it is hard to be integrated at the time of precompression grant. Consequently, the precompression to need can be given even if it does not make extremely high the dimensional accuracy and attachment precision of a component part.

[0010]

[Embodiment of the Invention] Drawing 1 shows one example of the gestalt of operation of this invention. the front end section (left end section of drawing 1 ) of the pinion shaft 1 arranged in the cross direction (longitudinal direction of drawing 1 ) of a car is made to carry out serration engagement of the inner skin of this body 18, and the front end section of the above-mentioned pinion shaft 1, while being closed, inserting in and coming out and attaching outside the body 18 formed in the inner circumference edge of an end flange 2 In the state of attachment by the automobile, the back end section of the driveshaft which is not illustrated to the above-mentioned end flange 2 is connected, and the rotation drive of the above-mentioned pinion shaft 1 is enabled. Moreover, the moderation pinion 4 is fixed to the part located in the

casing 3 which dedicated the differential gear in the back end section (right end section of drawing 1 ) of the above-mentioned pinion shaft 1. This moderation pinion 4 meshes with the moderation main wheel which was supported free [ rotation in the above-mentioned casing 3 ] and which is not illustrated.

[0011] The cylinder-like through tube 5 which makes the last side attachment wall of the above-mentioned casing 3 open the inside and outside of this casing 3 for free passage is formed, and only rotation is supporting the above-mentioned pinion shaft 1 free inside this through tube 5. For this reason, the outer ring of spiral wound gasket 6 of a cylindrical shape is fixed inside the above-mentioned through tube 5. The perimeter is covered and the mounting flange 19 is formed in the pars intermedia peripheral face of this outer ring of spiral wound gasket 6. And support immobilization of the above-mentioned outer ring of spiral wound gasket 6 is carried out inside the above-mentioned through tube 5 by [ which formed in the above-mentioned casing 3 the bolts 21 and 21 which inserted in the through-holes 20 and 20 formed in this mounting flange 19 ] \*\*\*\*ing, screwing in holes 22 and 22 and binding further. In addition, between the single-sided side (right lateral of drawing 1 ) of the above-mentioned mounting flange 19, and the front end side (left end side of drawing 1 ) of the above-mentioned casing 3, it has prevented that cover the perimeter, pinch an annular gasket and a lubricating oil is revealed from between the above-mentioned casing 3 and outer rings of spiral wound gasket 6.

[0012] The circular-cone concave surface-like outer-ring-of-spiral-wound-gasket orbit 9 is formed in the inner skin back end approach part of the above-mentioned outer ring of spiral wound gasket 6, and, similarly the outer-ring-of-spiral-wound-gasket orbit 13 of an angular mold is formed in a front end approach part, respectively. On the other hand, the circular-cone convex-like inner-ring-of-spiral-wound-gasket orbit 10 is directly formed in the peripheral face of this pinion shaft 1 at the pars intermedia back end approach part of the above-mentioned pinion shaft 1. And 11 and 11 are prepared at two or more circular-cones time between this inner-ring-of-spiral-wound-gasket orbit 10 and the above-mentioned outer-ring-of-spiral-wound-gasket orbit 9, and the circular-cone roller bearing 12 which is the second anti-friction bearing is constituted.

[0013] On the other hand, a narrow diameter portion 23 is formed in the first portion (left half part of drawing 1 ) of the above-mentioned pinion shaft 1, and the section (right half part of drawing 1 ) is made to follow this narrow diameter portion 23 by the step 24 in the second half. And an inner ring of spiral wound gasket 8 is attached outside this narrow diameter portion 23, and this inner ring of spiral wound gasket 8 is pinched between the above-mentioned step 24 and the body 18 of said end flange 2. that is, the above-mentioned inner ring of spiral wound gasket 8 is forced on the above-mentioned step 24 by being closed at the front end section of the above-mentioned pinion shaft 1, inserting in and appearing in it, and stuffing this body 18 into it by the predetermined force. The inner-ring-of-spiral-wound-gasket orbit 14 of an angular mold is formed in the peripheral face of this inner ring of spiral wound gasket 8, two or more balls 15 and 15 are formed between this inner-ring-of-spiral-wound-gasket orbit 14 and the above-mentioned outer-ring-of-spiral-wound-gasket orbit 13, and the ball bearing 16 which is the first anti-friction bearing is constituted. The above-mentioned pinion shaft 1 is supported free [ rotation ] to the above-mentioned casing 3 by 12 and the ball bearing 16 at these circular-cones time. Moreover, predetermined precompression is given to the above-mentioned both bearings 12 and 16 by forcing the above-mentioned inner ring of spiral wound gasket 8 on the above-mentioned step 24 by the above-mentioned body 18.

[0014] Moreover, inner fitting immobilization of the periphery edge of a seal ring 17 is carried out at the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner circumference edge of this seal ring 17 is made to \*\*\*\* to the peripheral face of the inner ring of spiral wound gasket 8 which constitutes the above-mentioned ball bearing 16. In addition, it holds down to this seal ring 17, it equips with a ring 25, and contact pressure of the inner circumference edge of this seal ring 17 and the peripheral face of the above-mentioned inner ring of spiral wound gasket 8 is enlarged enough. Therefore, it can fully prevent that the lubricating oil which entered inside the above-mentioned outer ring of spiral wound gasket 6 begins to leak outside through the above-mentioned seal ring 17.

[0015] Furthermore, the perimeter is covered and the fitting stop of the periphery edge of the second seal ring 26 is carried out at the back end section inner skin of the above-mentioned outer ring of spiral wound gasket 6 located in said moderation pinion 4 side. It is what this second seal ring 26 made a part for a periphery flank rodding, and used a part for an inner circumference flank as the seal lip made of rubber, and the point (inner circumference edge) of this seal lip is divided into the branch towards the shaft-orientations opposite side. And the perimeter is covered and the inner circumference edge of this seal lip is made to \*\*\*\* to the back end section peripheral face of said pinion shaft 1.

[0016] The bearing unit for pinion shaft support of the differential gear of this invention constituted as mentioned above supports the pinion shaft 1, enabling free rotation, and the operation at the time of transmitting rotation of the drive shaft which is a driving shaft to a moderation main wheel through this

pinion shaft 1 and the moderation pinion 4 is the same as that of the case of structure conventionally which was mentioned above.

[0017] Especially, by having formed in the peripheral face of the above-mentioned pinion shaft 1 directly the inner-ring-of-spiral-wound-gasket orbit 10 which constitutes the above-mentioned circular-cone roller bearing 12, in the case of the bearing unit for pinion shaft support of the differential gear of this invention, a component part decreases, and the dimension error of a component part becomes it is hard to be integrated at the time of precompression grant. Consequently, the precompression to need can be given even if it does not make extremely high the dimensional accuracy and attachment precision of a component part.

[0018] Moreover, in the case of the example of illustration, it can prevent that a foreign matter enters in these both bearings 16 and 12, securing the lubricity of the ball bearing 16 which is the second anti-friction bearing, and the circular-cone roller bearing 12 for a start. Namely, since the lubricating oil is stored inside [ lower ] the casing 3 of a differential gear, the lower part of the slide contact sections of the inner circumference edge of the second seal ring 26 of the above and the back end section peripheral face of the above-mentioned pinion shaft 1 will be in the condition of having been immersed into the above-mentioned lubricating oil. Moreover, the contact pressure of the inner circumference edge of the second seal ring 26 of the above and the back end section peripheral face of the pinion shaft 1 in the above-mentioned slide contact section is based only on the elasticity of the rubber which constitutes the inner circumference edge of the second seal ring 26 of the above. Therefore, some lubricating oils which exist in the above-mentioned casing 3 ooze out to the above-mentioned circular-cone roller bearing 12 side through the lower part of the above-mentioned slide contact sections. namely, the molecule of an oil -- \*\*\*\* -- since it is small, if the inner circumference edge of a seal lip and the peripheral face of the pinion shaft 1 which constitute the second seal ring 26 of the above rub mutually in the condition of having contacted lightly, the lubricating oil in the above-mentioned casing 3 will ooze out to the above-mentioned circular-cone roller bearing 12 side, and will carry out the lubrication of this circular-cone roller bearing 12. since this circular-cone roller bearing 12 is formed in the location contiguous to the second seal ring 26 of the above -- the above-mentioned stain appearance -- the bottom, most lubricating oils are incorporated in the above-mentioned circular-cone roller bearing 12, and it performs sufficiently effectively the lubrication of this circular-cone roller bearing 12.

[0019] On the other hand, compared with the molecule of the above-mentioned lubricating oil, since it is far large, the particle size of the foreign matter mixed into the lubricating oil which exists in the above-mentioned casing 3 cannot pass the above-mentioned slide contact section, but stops in the above-mentioned casing 3. Therefore, receiving damage with the foreign matter which the above-mentioned circular-cone roller bearing 12 and a ball bearing 16 mixed into the lubricating oil is lost.

[0020] In addition, since the ball bearing 16 which is the first anti-friction bearing is formed in the location distant from the second seal ring 26 of the above, if the amount of the lubricating oil which reaches this ball bearing 16 part is measured against the amount of the lubricating oil which reaches the above-mentioned circular-cone roller bearing 12, it will decrease. However, the lubrication of this ball bearing 16 does not become poor for the following reasons. That is, since a ball bearing 16 has the small touch area of an orbital plane and a rolling element, it can perform sufficient lubrication to few lubricating oils compared with the circular-cone roller bearing 12. Moreover, the load-carrying capacity covering the thrust direction receives the great portion of thrust loading which joins the above-mentioned pinion shaft 1 based on engagement with the moderation pinion 4 and a moderation main wheel at the time of operation of a differential gear by the above-mentioned big circular-cone roller bearing 12. therefore, thrust loading which gets across to the above-mentioned ball bearing 16 -- \*\*\*\* -- it is small. If only the above-mentioned ball bearing 16 supplies a small amount of lubricating oil for this reason, the damage on printing etc. is not generated.

[0021]

[Effect of the Invention] Since the bearing unit for pinion shaft support of the differential gear of this invention is constituted as it was stated above, and it acts, it easy-izes precompression management, mitigates the time and effort for fitness precompression grant, and can plan cost reduction. Moreover, effectiveness, such as reduction in the noise and improvement in endurance, is also acquired by exact precompression grant.

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TECHNICAL FIELD

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[Industrial Application] This invention relates to amelioration of the bearing unit for pinion shaft support of a differential gear for supporting the pinion shaft which constitutes the differential gear (the last reducer) of an automobile free [ rotation ] inside casing (differential case).

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PRIOR ART

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[Description of the Prior Art] As a differential gear which changes a hand of cut into a right angle, structure as shown in drawing 2 is indicated by JP,53-74653,A at the same time it prepares in the middle of the power transfer system of an automobile and slows down rotation of a driveshaft. First, it explains about structure conventionally which was shown in this drawing 2 . In addition, in the case of the differential gear for FR vehicles (front-end engine rear drive vehicle), the cross direction in the following explanation is described. In the case of the differential gear included in automobiles which have drive formats other than FR vehicle, such as FF vehicle (front-end engine front drive vehicle), RR vehicle (postposing engine rear drive vehicle), and a midship engine vehicle, a cross direction is not necessarily the same.

[0003] The front end section (left end section of drawing 2 ) of the pinion shaft 1 arranged in the cross direction (longitudinal direction of drawing 2 ) of a car is enabling connection in the back end section of the driveshaft which is not illustrated by the end flange 2 which carried out outer fitting immobilization at the front end section of this pinion shaft 1. Moreover, the moderation pinion 4 is fixed to the part located in the casing 3 which dedicated the differential gear in the back end section (right end section of drawing 2 ) of the above-mentioned pinion shaft 1. This moderation pinion 4 meshes with the moderation main wheel which was supported free [ rotation in the above-mentioned casing 3 ] and which is not illustrated.

[0004] The cylinder-like through tube 5 which makes the last side attachment wall of the above-mentioned casing 3 open the inside and outside of this casing 3 for free passage is formed, and only rotation is supporting the above-mentioned pinion shaft 1 free inside this through tube 5. That is, while carrying out screwing immobilization of the outer ring of spiral wound gasket 6 of a cylindrical shape inside the above-mentioned through tube 5, outer fitting immobilization of one pair of inner rings of spiral wound gasket 7 and 8 is carried out approximately at the above-mentioned pinion shaft 1. And 11 and 11 are prepared at two or more circular-cones time between the outer-ring-of-spiral-wound-gasket orbit 9 formed in the back end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner-ring-of-spiral-wound-gasket orbit 10 formed in the peripheral face of the inner ring of spiral wound gasket 7 on the backside, and the circular-cone roller bearing 12 is constituted. Moreover, two or more balls 15 and 15 are formed between the outer-ring-of-spiral-wound-gasket orbit 13 formed in the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner-ring-of-spiral-wound-gasket orbit 14 formed in the peripheral face of the inner ring of spiral wound gasket 8 by the side of before, and the ball bearing 16 is constituted. The above-mentioned pinion shaft 1 is supported free [ rotation ] to the above-mentioned casing 3 by these circular-cones roller bearing 12 and the ball bearing 16. Furthermore, the periphery edge of a seal ring 17 is stopped to the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner circumference edge of this seal ring 17 is made to \*\*\*\* on the front face of the inner ring of spiral wound gasket 8 which constitutes the above-mentioned ball bearing 16.

[0005] At the time of operation of the differential gear constituted as mentioned above, the moderation main wheel which is not illustrated rotates with rotation of the above-mentioned pinion shaft 1. This moderation main wheel runs through its lubricating oil (differential oil) stored in the above-mentioned casing 3. Consequently, the droplet of a lubricating oil enters in the above-mentioned outer ring of spiral wound gasket 6, and the lubrication of the above-mentioned circular-cone roller bearing 12 and the ball bearing 16 is carried out.

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EFFECT OF THE INVENTION

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[Effect of the Invention] Since the bearing unit for pinion shaft support of the differential gear of this invention is constituted as it was stated above, and it acts, it easy-izes precompression management, mitigates the time and effort for fitness precompression grant, and can plan cost reduction. Moreover, effectiveness, such as reduction in the noise and improvement in endurance, is also acquired by exact precompression grant.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] Precompression management of the circular-cone roller bearing 12 for [ which was shown in drawing 2 ] supporting the pinion shaft 1 in the case of structure, enabling free rotation and a ball bearing 16 is conventionally difficult. That is, in the case of structure, it has the inner rings of spiral wound gasket 7 and 8 which carried out mutually-independent conventionally [ above-mentioned ], and outer fitting immobilization of each [ these ] inner rings of spiral wound gasket 7 and 8 is carried out at the pinion shaft 1, respectively. And the binding force of the nut 28 for fixing an end flange 2 to the front end section of the pinion shaft 1 is adjusted, the force which presses the one above-mentioned pair of inner rings of spiral wound gasket 7 and 8 to shaft orientations is regulated, and precompression management of each above-mentioned bearing 12 and 16 is aimed at.

[0007] When the precompression of each [ these ] bearing 12 and 16 is managed with such structure, it is hard coming for the pile of each above-mentioned inner rings of spiral wound gasket 7 and 8, the pinion shaft 1 and the dimension error of an end flange 2, or an attachment error to perform exact precompression management. The bearing unit for pinion shaft support of the differential gear of this invention is invented in view of such a situation.

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**MEANS**

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[Means for Solving the Problem] The bearing unit for pinion shaft support of the differential gear of this invention The pinion shaft which fixed the moderation pinion which enables connection of the end section at the edge of a driving shaft, and meshes with a moderation main wheel to the other end like the bearing unit for pinion shaft support of the conventional differential gear mentioned above, The outer ring of spiral wound gasket fixed to this casing where it has been arranged around this pinion shaft at this pinion shaft and this alignment and the side attachment wall of casing of a differential gear is penetrated to an oiltight, It is prepared between the two-place location isolated to shaft orientations by the inner skin of this outer ring of spiral wound gasket, and the two-place location isolated to shaft orientations in the pars intermedia of the above-mentioned pinion shaft. One pair of anti-friction bearings which support the two-place location isolated to shaft orientations free [ rotation ] to the above-mentioned casing in the pars intermedia of this pinion shaft, It is prepared at the end section inner skin, the above-mentioned pinion shaft, or this pinion shaft of the above-mentioned outer ring of spiral wound gasket between the peripheral faces of the inner ring of spiral wound gasket by which outer fitting immobilization was carried out, and has the seal ring with which the lubricating oil which exists in the above-mentioned casing prevents revealing outside. And the first anti-friction bearing supported for a side far from the above-mentioned moderation pinion among the above-mentioned pinion shafts, enabling free rotation is a ball bearing, and the second anti-friction bearing supported for the same side near the above-mentioned moderation pinion, enabling free rotation is circular-cone roller bearing. Especially, in the bearing unit for pinion shaft support of the differential gear of this invention, the inner-ring-of-spiral-wound-gasket orbit which constitutes the above-mentioned circular-cone roller bearing is directly formed in the peripheral face of a pinion shaft.

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OPERATION

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[Function] The operation at the time of the bearing unit for pinion shaft support of the differential gear of this invention constituted as mentioned above supporting a pinion shaft, enabling free rotation, and transmitting rotation of a driving shaft to a moderation main wheel through this pinion shaft and a moderation pinion is the same as that of the case of structure conventionally which was mentioned above. Especially, by having formed the inner-ring-of-spiral-wound-gasket orbit of circular-cone roller bearing in the peripheral face of a pinion shaft directly, in the case of the bearing unit for pinion shaft support of the differential gear of this invention, a component part decreases, and the dimension error of a component part becomes it is hard to be integrated at the time of precompression grant. Consequently, the precompression to need can be given even if it does not make extremely high the dimensional accuracy and attachment precision of a component part.

[0010]

[Embodiment of the Invention] Drawing 1 shows one example of the gestalt of operation of this invention. the front end section (left end section of drawing 1 ) of the pinion shaft 1 arranged in the cross direction (longitudinal direction of drawing 1 ) of a car is made to carry out serration engagement of the inner skin of this body 18, and the front end section of the above-mentioned pinion shaft 1, while being closed, inserting in and coming out and attaching outside the body 18 formed in the inner circumference edge of an end flange 2 In the state of attachment by the automobile, the back end section of the driveshaft which is not illustrated to the above-mentioned end flange 2 is connected, and the rotation drive of the above-mentioned pinion shaft 1 is enabled. Moreover, the moderation pinion 4 is fixed to the part located in the casing 3 which dedicated the differential gear in the back end section (right end section of drawing 1 ) of the above-mentioned pinion shaft 1. This moderation pinion 4 meshes with the moderation main wheel which was supported free [ rotation in the above-mentioned casing 3 ] and which is not illustrated.

[0011] The cylinder-like through tube 5 which makes the last side attachment wall of the above-mentioned casing 3 open the inside and outside of this casing 3 for free passage is formed, and only rotation is supporting the above-mentioned pinion shaft 1 free inside this through tube 5. For this reason, the outer ring of spiral wound gasket 6 of a cylindrical shape is fixed inside the above-mentioned through tube 5. The perimeter is covered and the mounting flange 19 is formed in the pars intermedia peripheral face of this outer ring of spiral wound gasket 6. And support immobilization of the above-mentioned outer ring of spiral wound gasket 6 is carried out inside the above-mentioned through tube 5 by [ which formed in the above-mentioned casing 3 the bolts 21 and 21 which inserted in the through-holes 20 and 20 formed in this mounting flange 19 ] \*\*\*\*ing, screwing in holes 22 and 22 and binding further. In addition, between the single-sided side (right lateral of drawing 1 ) of the above-mentioned mounting flange 19, and the front end side (left end side of drawing 1 ) of the above-mentioned casing 3, it has prevented that cover the perimeter, pinch an annular gasket and a lubricating oil is revealed from between the above-mentioned casing 3 and outer rings of spiral wound gasket 6.

[0012] The circular-cone concave surface-like outer-ring-of-spiral-wound-gasket orbit 9 is formed in the inner skin back end approach part of the above-mentioned outer ring of spiral wound gasket 6, and, similarly the outer-ring-of-spiral-wound-gasket orbit 13 of an angular mold is formed in a front end approach part, respectively. On the other hand, the circular-cone convex-like inner-ring-of-spiral-wound-gasket orbit 10 is directly formed in the peripheral face of this pinion shaft 1 at the pars intermedia back end approach part of the above-mentioned pinion shaft 1. And 11 and 11 are prepared at two or more circular-cones time between this inner-ring-of-spiral-wound-gasket orbit 10 and the above-mentioned outer-ring-of-spiral-wound-gasket orbit 9, and the circular-cone roller bearing 12 which is the second anti-friction bearing is constituted.

[0013] On the other hand, a narrow diameter portion 23 is formed in the first portion (left half part of

drawing 1 ) of the above-mentioned pinion shaft 1, and the section (right half part of drawing 1 ) is made to follow this narrow diameter portion 23 by the step 24 in the second half. And an inner ring of spiral wound gasket 8 is attached outside this narrow diameter portion 23, and this inner ring of spiral wound gasket 8 is pinched between the above-mentioned step 24 and the body 18 of said end flange 2. that is, the above-mentioned inner ring of spiral wound gasket 8 is forced on the above-mentioned step 24 by being closed at the front end section of the above-mentioned pinion shaft 1, inserting in and appearing in it, and stuffing this body 18 into it by the predetermined force. The inner-ring-of-spiral-wound-gasket orbit 14 of an angular mold is formed in the peripheral face of this inner ring of spiral wound gasket 8, two or more balls 15 and 15 are formed between this inner-ring-of-spiral-wound-gasket orbit 14 and the above-mentioned outer-ring-of-spiral-wound-gasket orbit 13, and the ball bearing 16 which is the first anti-friction bearing is constituted. The above-mentioned pinion shaft 1 is supported free [ rotation ] to the above-mentioned casing 3 by 12 and the ball bearing 16 at these circular-cones time. Moreover, predetermined precompression is given to the above-mentioned both bearings 12 and 16 by forcing the above-mentioned inner ring of spiral wound gasket 8 on the above-mentioned step 24 by the above-mentioned body 18.

[0014] Moreover, inner fitting immobilization of the periphery edge of a seal ring 17 is carried out at the front end section inner skin of the above-mentioned outer ring of spiral wound gasket 6, and the inner circumference edge of this seal ring 17 is made to \*\*\*\* to the peripheral face of the inner ring of spiral wound gasket 8 which constitutes the above-mentioned ball bearing 16. In addition, it holds down to this seal ring 17, it equips with a ring 25, and contact pressure of the inner circumference edge of this seal ring 17 and the peripheral face of the above-mentioned inner ring of spiral wound gasket 8 is enlarged enough. Therefore, it can fully prevent that the lubricating oil which entered inside the above-mentioned outer ring of spiral wound gasket 6 begins to leak outside through the above-mentioned seal ring 17.

[0015] Furthermore, the perimeter is covered and the fitting stop of the periphery edge of the second seal ring 26 is carried out at the back end section inner skin of the above-mentioned outer ring of spiral wound gasket 6 located in said moderation pinion 4 side. It is what this second seal ring 26 made a part for a periphery flank rodding, and used a part for an inner circumference flank as the seal lip made of rubber, and the point (inner circumference edge) of this seal lip is divided into the branch towards the shaft-orientations opposite side. And the perimeter is covered and the inner circumference edge of this seal lip is made to \*\*\*\* to the back end section peripheral face of said pinion shaft 1.

[0016] The bearing unit for pinion shaft support of the differential gear of this invention constituted as mentioned above supports the pinion shaft 1, enabling free rotation, and the operation at the time of transmitting rotation of the drive shaft which is a driving shaft to a moderation main wheel through this pinion shaft 1 and the moderation pinion 4 is the same as that of the case of structure conventionally which was mentioned above.

[0017] Especially, by having formed in the peripheral face of the above-mentioned pinion shaft 1 directly the inner-ring-of-spiral-wound-gasket orbit 10 which constitutes the above-mentioned circular-cone roller bearing 12, in the case of the bearing unit for pinion shaft support of the differential gear of this invention, a component part decreases, and the dimension error of a component part becomes it is hard to be integrated at the time of precompression grant. Consequently, the precompression to need can be given even if it does not make extremely high the dimensional accuracy and attachment precision of a component part.

[0018] Moreover, in the case of the example of illustration, it can prevent that a foreign matter enters in these both bearings 16 and 12, securing the lubricity of the ball bearing 16 which is the second anti-friction bearing, and the circular-cone roller bearing 12 for a start. Namely, since the lubricating oil is stored inside [ lower ] the casing 3 of a differential gear, the lower part of the slide contact sections of the inner circumference edge of the second seal ring 26 of the above and the back end section peripheral face of the above-mentioned pinion shaft 1 will be in the condition of having been immersed into the above-mentioned lubricating oil. Moreover, the contact pressure of the inner circumference edge of the second seal ring 26 of the above and the back end section peripheral face of the pinion shaft 1 in the above-mentioned slide contact section is based only on the elasticity of the rubber which constitutes the inner circumference edge of the second seal ring 26 of the above. Therefore, some lubricating oils which exist in the above-mentioned casing 3 ooze out to the above-mentioned circular-cone roller bearing 12 side through the lower part of the above-mentioned slide contact sections. namely, the molecule of an oil -- \*\*\*\* -- since it is small, if the inner circumference edge of a seal lip and the peripheral face of the pinion shaft 1 which constitute the second seal ring 26 of the above rub mutually in the condition of having contacted lightly, the lubricating oil in the above-mentioned casing 3 will ooze out to the above-mentioned circular-cone roller bearing 12 side, and will carry out the lubrication of this circular-cone roller bearing 12. since this circular-cone roller bearing 12 is formed in the location contiguous to the second

seal ring 26 of the above -- the above-mentioned stain appearance -- the bottom, most lubricating oils are incorporated in the above-mentioned circular-cone roller bearing 12, and it performs sufficiently effectively the lubrication of this circular-cone roller bearing 12.

[0019] On the other hand, compared with the molecule of the above-mentioned lubricating oil, since it is far large, the particle size of the foreign matter mixed into the lubricating oil which exists in the above-mentioned casing 3 cannot pass the above-mentioned slide contact section, but stops in the above-mentioned casing 3. Therefore, receiving damage with the foreign matter which the above-mentioned circular-cone roller bearing 12 and a ball bearing 16 mixed into the lubricating oil is lost.

[0020] In addition, since the ball bearing 16 which is the first anti-friction bearing is formed in the location distant from the second seal ring 26 of the above, if the amount of the lubricating oil which reaches this ball bearing 16 part is measured against the amount of the lubricating oil which reaches the above-mentioned circular-cone roller bearing 12, it will decrease. However, the lubrication of this ball bearing 16 does not become poor for the following reasons. That is, since a ball bearing 16 has the small touch area of an orbital plane and a rolling element, it can perform sufficient lubrication to few lubricating oils compared with the circular-cone roller bearing 12. Moreover, the load-carrying capacity covering the thrust direction receives the great portion of thrust loading which joins the above-mentioned pinion shaft 1 based on engagement with the moderation pinion 4 and a moderation main wheel at the time of operation of a differential gear by the above-mentioned big circular-cone roller bearing 12. therefore, thrust loading which gets across to the above-mentioned ball bearing 16 -- \*\*\*\* -- it is small. If only the above-mentioned ball bearing 16 supplies a small amount of lubricating oil for this reason, the damage on printing etc. is not generated.

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[Translation done.]

## \* NOTICES \*

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The vertical section side elevation showing one example of the gestalt of operation of this invention.

[Drawing 2] The vertical section side elevation showing one example of structure conventionally.

[Description of Notations]

- 1 Pinion Shaft
- 2 End Flange
- 3 Casing
- 4 Moderation Pinion
- 5 Through Tube
- 6 Outer Ring of Spiral Wound Gasket
- 7 Eight Inner ring of spiral wound gasket
- 9 Outer-Ring-of-Spiral-Wound-Gasket Orbit
- 10 Inner-Ring-of-Spiral-Wound-Gasket Orbit
- 11 Circular-Cone Time
- 12 Circular-Cone Roller Bearing
- 13 Outer-Ring-of-Spiral-Wound-Gasket Orbit
- 14 Inner-Ring-of-Spiral-Wound-Gasket Orbit
- 15 Ball
- 16 Ball Bearing
- 17 Seal Ring
- 18 Body
- 19 Mounting Flange
- 20 Through-hole
- 21 Bolt
- 22 Screw-Thread Hole
- 23 Narrow Diameter Portion
- 24 Step
- 25 Prevention Ring
- 26 Second Seal Ring
- 27 Spacer
- 28 Nut

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[Translation done.]

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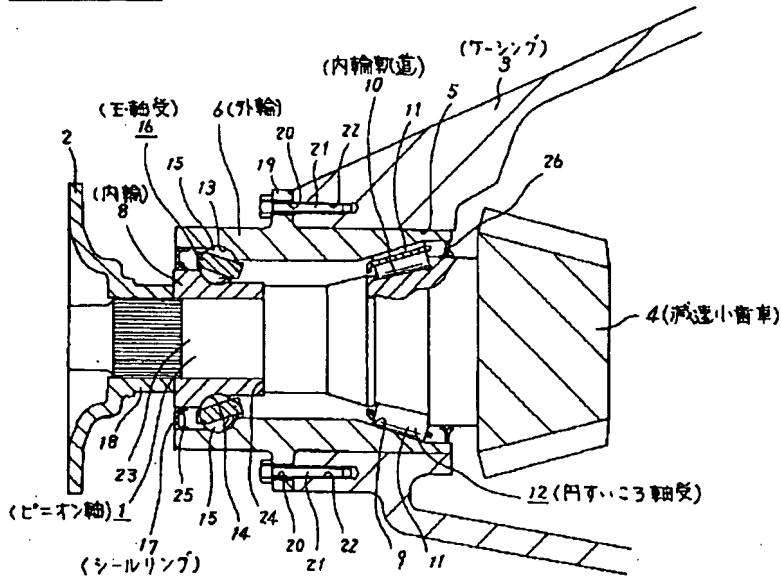
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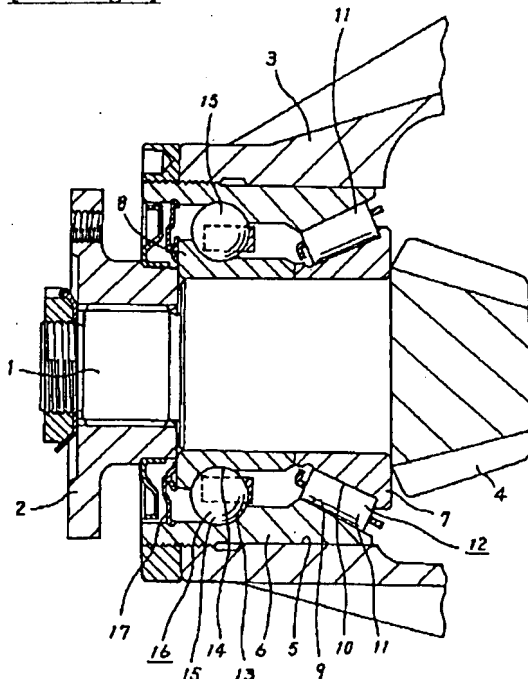
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## DRAWINGS

[Drawing 1]



[Drawing 2]





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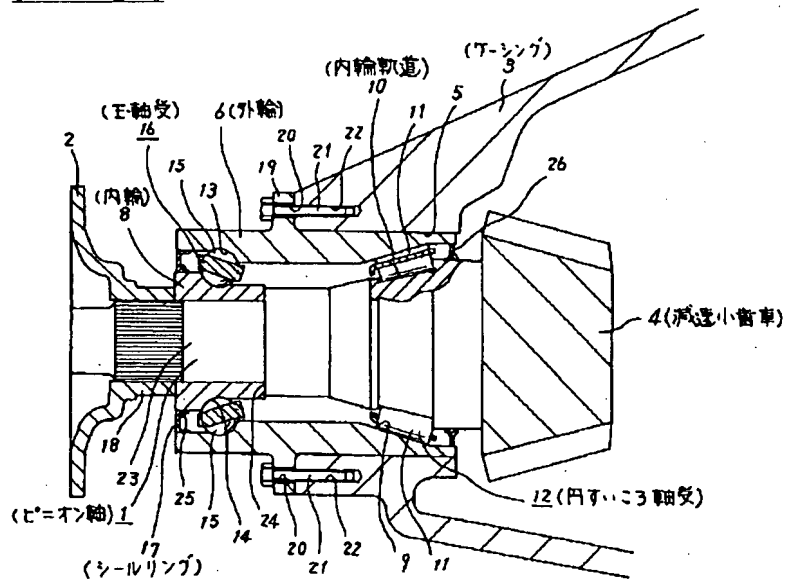
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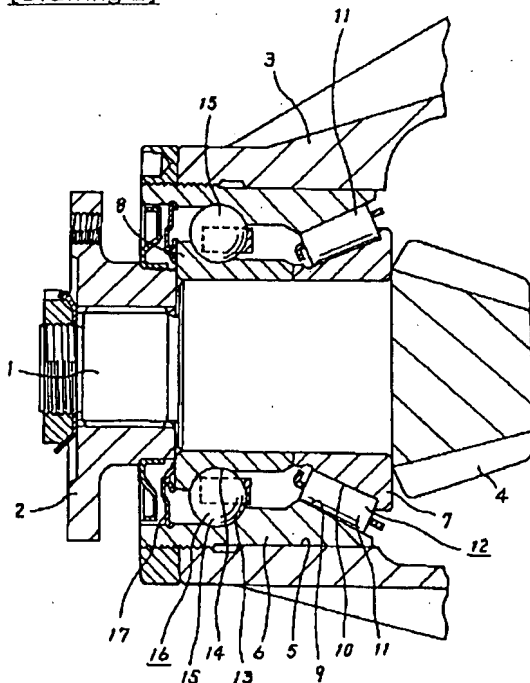
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## DRAWINGS

[Drawing 1]



[Drawing 2]



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[Translation done.]